Momentum Confinement at Low Torque*

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Momentum confinement was investigated in ELMy H-mode plasmas with elevated q_{min} (so as to avoid the complication of sawteeth from the analysis). Torque scans were performed at constant β_N, and the rotation profile was measured using charge exchange recombination (CER) spectroscopy. Studies of the mechanical angular momentum in the plasma show a non-uniform response to the applied neutral beam torque. This response translates into a torque dependence of the momentum confinement time, specifically showing that momentum confinement time degrades as the torque is increased. This is somewhat analogous to the more familiar observation of degradation of energy confinement with increased power. In hybrid plasmas, the opposite effect is observed, namely that momentum confinement improves with increased torque/rotation. The relative importance of ExB shearing between the two is modeled using GLF23 and may suggest a possible explanation.

Under nominally balanced neutral beam injection, the plasma maintains a significant rotation in the same direction as the plasma current (co-rotation). This rotation is related to the "intrinsic rotation" observed in the absence of auxiliary momentum input, although there is a subtle difference because balanced beam injection does not imply zero torque at all radii across the plasma profile. Any study of global momentum confinement must clearly account for this intrinsic rotation. The intrinsic rotation can be modeled as being due to an offset in the applied torque (i.e. an "anomalous torque"). This anomalous torque appears to have a magnitude comparable to one co-neutral beam source.

The relationship between χ_ϕ and χ_i are investigated as a function of rotation. In general, the two quantities tend to increase with minor radius, although χ_ϕ tends to peaks near ρ~0.7, while χ_i keeps increasing. The possible role of fast ion redistribution and its effect on the applied torque profile is considered.

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